

Radiology Corner

Hydropneumothorax versus Simple Pneumothorax

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Note: This is the full text version of the radiology corner question published in the July 2010 issue, with the abbreviated answer in the August 2010 issue.

Three cases are presented to compare and contrast the radiographic findings in hydropneumothorax versus simple pleural effusion. The first case is of a 72-year-old man with metastatic colon cancer presenting with worsening shortness of breath. Post-thoracentesis chest radiographs (Fig 1) and CT (Fig 2) demonstrate a hydropneumothorax. The second case is of a 67 year-old male with non-small cell lung carcinoma who developed a hydropneumothorax following percutaneous drain placement (Fig 3 and 4). A third case is presented of a 65 year-old male with a left-sided pleural effusion (Fig 5) for comparison. Hydropneumothorax consists of both free fluid and air within the pleural space with common etiologies being iatrogenic (post-thoracentesis), presence of gas forming organisms, and trauma. Simple pleural effusions consist of fluid only within the pleural space and are a result of increased hydrostatic pressure in the pulmonary vasculature, decreased oncotic pressure, or a combination of the two. The distinction between simple effusion and hydropneumothorax is usually straightforward and important in order to apply appropriate therapy. Also, detection of an air-fluid level could be the only indicator of a pneumothorax.

Summary of Findings:

Case 1

A 72-year-old man with metastatic colon cancer presented with worsening shortness of breath. Initial chest radiographs (not pictured) showed a large right-sided pleural effusion with rounded opacities in the right upper and lower lobes. The patient underwent thoracentesis. Post-procedural PA and lateral chest radiographs revealed a right-sided hydropneumothorax (Fig 1). A contrast-enhanced CT exam depicts the right-sided hydropneumothorax, with the horizontal air fluid interface (Fig 2). The fluid layers posteriorly, and the air rises ante-dependently.

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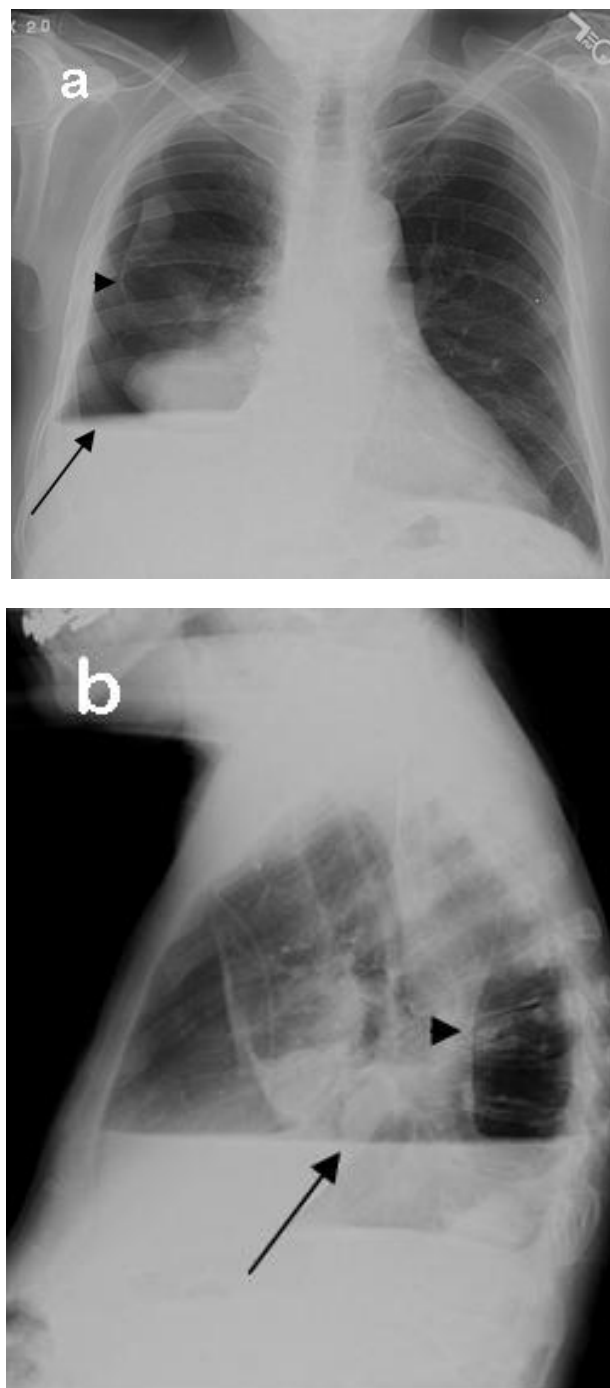


Fig 1: Post-thoracentesis PA (a) and lateral (b) chest radiographs show a right-sided hydropneumothorax. Note the air-fluid level (arrow), and pleural edge (arrowhead).

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE AUG 2010		2. REPORT TYPE		3. DATES COVERED 00-00-2010 to 00-00-2010	
4. TITLE AND SUBTITLE Hydropneumothorax versus Simple Pneumothorax				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Uniformed Services University of the Health Sciences, Department of Radiology and Radiological Sciences, 4301 Jones Bridge Road, Bethesda, MD, 20814				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 4	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

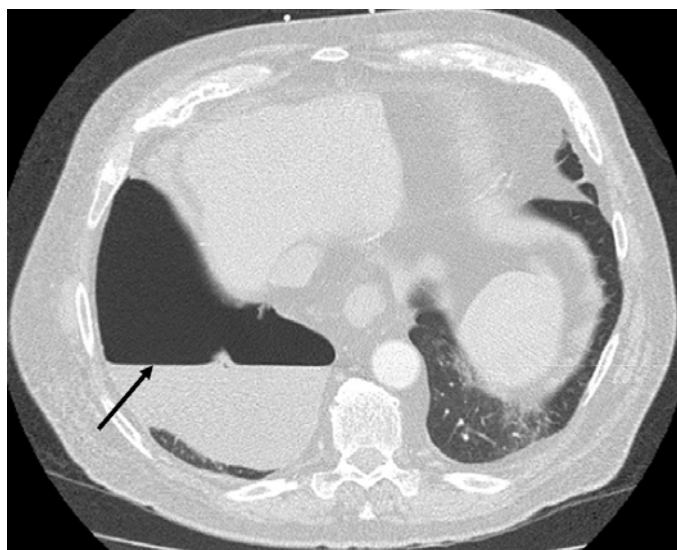


Fig 2: Axial contrast CT image demonstrates a right-sided hydropneumothorax in the first case. Note the air and fluid interface (arrow).

Diagnosis:

Hydropneumothorax

Case 2

A 67 year-old male with non-small cell lung carcinoma developed a hydropneumothorax following percutaneous placement of a drainage catheter. The post-procedural lateral chest radiograph demonstrates a horizontal air fluid interface and a pleural edge (Fig 3). The contrast-enhanced CT exam shows the left-sided air-fluid level (Fig 4).

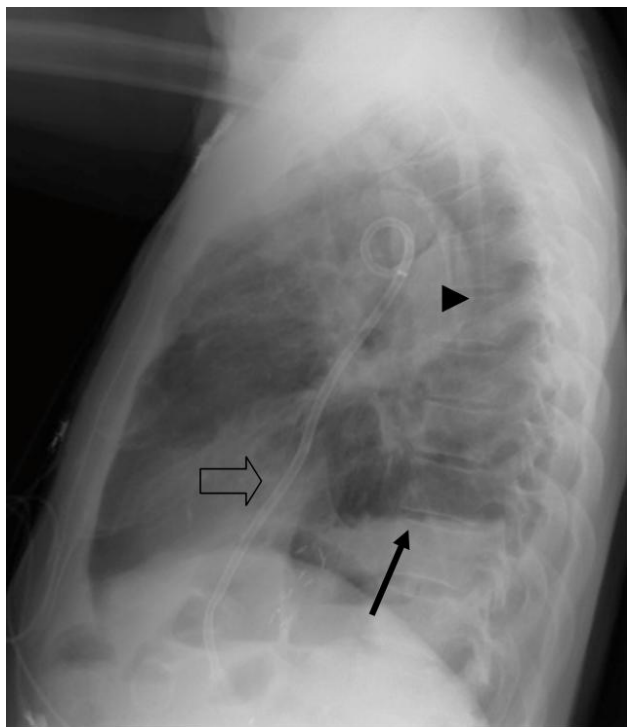


Fig 3: Post-procedural lateral chest radiograph in our second case shows an air-fluid level (arrow) posterior to the drainage catheter (open arrow) with a pleural edge seen more superiorly (arrowhead), consistent with hydropneumothorax.

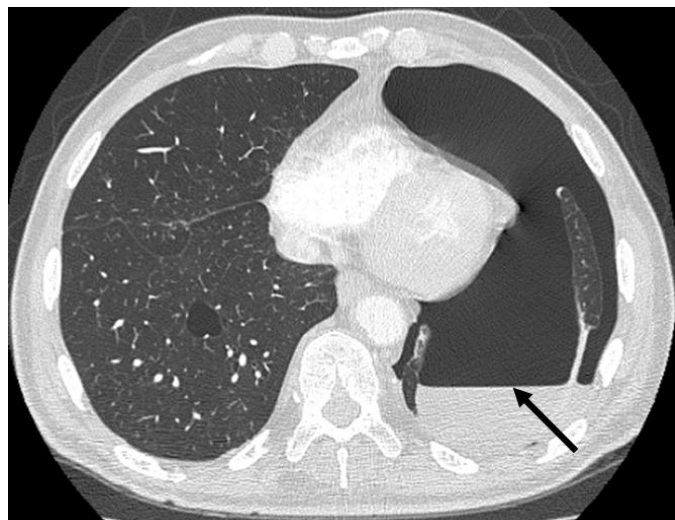


Fig 4: Post-procedural axial contrast CT image on our second case demonstrates a hydropneumothorax. Note the horizontal air fluid interface (arrow).

Case 3

A 65 year-old male post coronary artery bypass grafting presented with a left-sided pleural effusion. The PA chest radiograph demonstrates a meniscus along the left chest wall, with blunting of the left costophrenic angle and obscuration of the left hemidiaphragm (Fig 5). The meniscus finding supports lack of a pneumothorax as in this case.

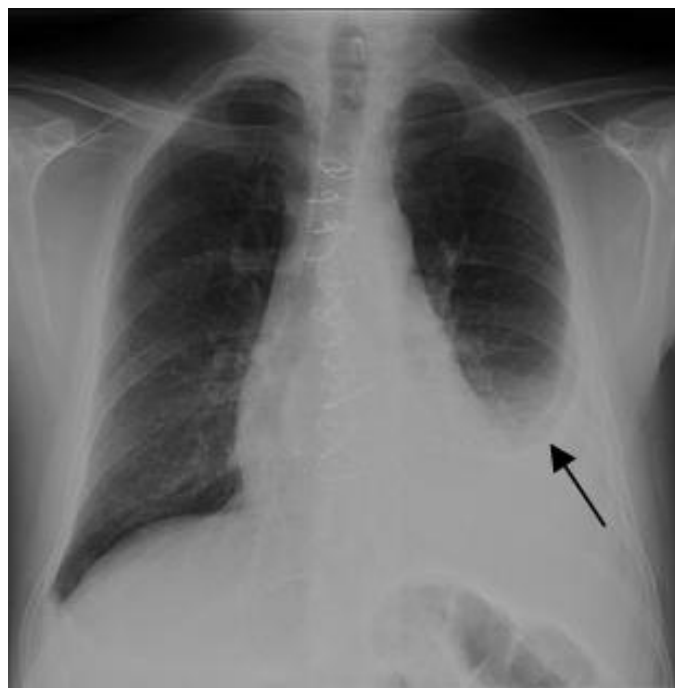


Fig 5: PA chest radiograph showing the “meniscus sign” (arrow) produced by a left pleural effusion.

Discussion

A hydropneumothorax is most commonly identified on PA and lateral chest radiographs but can also be seen on CT and less frequently using ultrasound. In a 1992 study by Targhetta et al., the presence of a hydropneumothorax was diagnosed using ultrasound and confirmed with plain radiographs and CT in all patients examined.¹ Any invasive procedure such as a transbronchial biopsy, chest tube placement or thoracentesis may be complicated by a post-procedure hydropneumothorax.² Other etiologies include neoplastic processes, post-traumatic, post-pneumectomy, infection, pulmonary infarction, cystic lung disease, obstructive lung disease, and rarely, connective tissue disorders such as Marfan's or Ehlers-Danlos syndromes.²

A model has been created to replicate a hydropneumothorax (Fig 6).³ In this model, a red balloon is used to simulate a lung, the wine glass represents the chest wall and milk is used to simulate a pleural effusion. As evidenced by the model, when free air is present above the effusion (milk in the model) the air fluid interface becomes clearly defined. This interface is what creates the edge noted on chest radiographs.



Fig 6: Model using a balloon to illustrate the horizontal interface of air and fluid (arrowheads) created by a hydropneumothorax (left image).

To compare the radiographic features of a hydropneumothorax versus a simple pleural effusion, a similar model as used above can be constructed to illustrate a pleural effusion (Fig 7) showing how the milk is compressed along side of the inflated balloon forming a meniscus-like edge. Like a properly inflated lung, there is no room or possibility for an air-fluid level.

See figures 8 and 9 for comparison of analogous model and representative cases. The meniscus sign is an important finding that distinguishes a simple effusion from a hydropneumothorax.

In healthy individuals there is normally a small amount of fluid, 5-15 ml, within the pleural space which limits friction between the pleura. Excess pleural fluid forms when there is an imbalance between production and absorption due to a pathologic process.⁴ On lateral upright radiographs, pleural fluid in amounts as little as 25-50 ml blunt the costophrenic angles while on the frontal radiograph approximately 200 ml must be present to obscure the costophrenic sulci.⁴ The chest radiograph (Fig 5) demonstrates the typical features of a large pleural effusion: a meniscus along the left chest wall, complete obscuration of the left costophrenic angle and obliteration of the left hemidiaphragm, which indicates at least 500 ml of fluid is present.



Fig. 7. This balloon is inflated against the glass and simulates an apparent meniscus (arrows) produced by a pleural effusion in the absence of a pneumothorax. The balloon represents the lung, the glass the chest wall and the milk an effusion. Photos by Dr. Les Folio and contributed by Dr. Scott Trask.

In contradistinction, a meniscus is not observed in a hydropneumothorax because the trapped air leads to an increase in intrathoracic pressure that abuts the fluid in the pleural space and produces a horizontal air-fluid interface. Differentiating between hydropneumothorax and a simple pleural effusion is necessary because appropriate treatment of a hydropneumothorax often requires specific site placement of two chest tubes; one to drain the fluid and the other to remove the air.⁵ Conversely, simple effusions that require treatment are usually managed with a single chest tube.

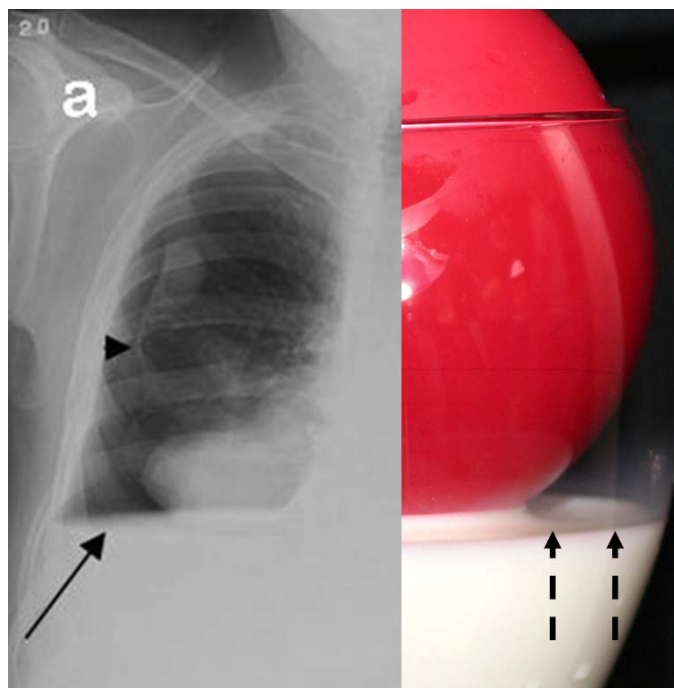


Fig. 8. Comparison of our patient with hydropneumothorax (left image) and the model representing the lung (balloon) and the fluid level (dotted arrows).

In summary, basic findings such as an air-fluid level on the chest x-ray may be an important clue to an important finding such as hydropneumothorax. It may be the only clue that a pneumothorax exists. The finding of a meniscus differentiates a simple pleural effusion from hydropneumothorax. The cases and analogous models presented here should highlight these differences and effectively guide one in understanding the processes resulting in the findings.

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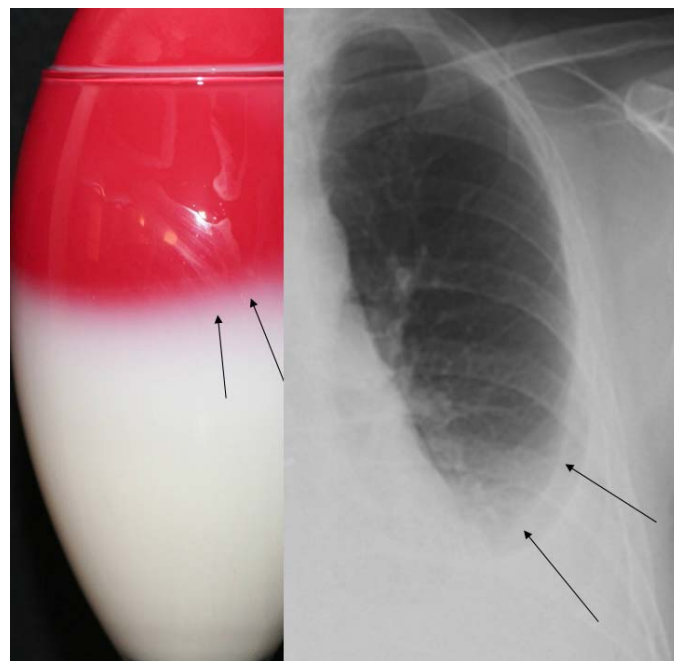


Fig. 9. Comparison of inflated balloon in wine glass (left) simulating meniscus sign (arrows) with case of pleural effusion without pneumothorax on the right.

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